Raspberry Pies and PiGates

BY DON ROTOLO,* N2IRZ

Last time, I wrote about using a Raspberry Pi mini-computer and a Coastal Chipworks TNC-Pi to create a TARPN node, a building block in an effort to make packet networking fun again. This month, using the same HAT ("hardware attached on top"), we'll take a look at the PiGate emergency email gateway from Mark Griffin, KDØQYN.

Before we get started with the PiGate, just keep in mind that a Raspberry Pi <https://www.raspberrypi.org/> is a bona-fide mini-computer. You can connect a keyboard, mouse, and monitor and do useful things with it. The latest Pi 3 Model B version has a fairly powerful processor (1.2 GHz quad-core), built-in 802.11n WiFi, Bluetooth, Ethernet, HDMI, and USB...and it costs only $35 full retail. That's cheap enough to turn it into a kitchen exhaust fan controller (although a Pi Zero, at $5, might be more economical), and powerful enough to browse the web or even compose this month's column. Raspbian Linux is a fine operating system, and there are lots and lots of software applications you can run.

PiGate

If you followed along with me last time (March 2017) and built a TARPN node, then you have nearly everything you need to build a PiGate — but I am getting ahead of myself here.

A PiGate <http://www.pigate.net> is a small piece of hardware that serves as an emergency email gateway, leveraging the Winlink global radio email network <https://www.winlink.org/> to enable emergency communications from a disaster location. Local users connect via WiFi and access the PiGate using their smartphone's email application, or the built-in email client using a web browser.

These kinds of emergency communications (EmComm) are one of the primary purposes of amateur radio. While tactical communications — getting supplies or personnel to a location, for example — are often best handled by voice, common health and welfare (H&W) communications from victims of the disaster are better handled by email or text. National Traffic System (NTS) messages may be adequate, but the procedures are cumbersome, non-hams are bewildered by the forms, and long messages are distinctly frowned upon in my experience. Email is a familiar and comfortable communications medium, delivery is fairly fast and reliable, and message length is not that important.

One of the best features of the PiGate is that users just connect with a web browser using their WiFi-enabled device. Whether that's a phone, tablet, or computer, it's something people know and are familiar with. For those without a device, the system operator can surely loan them something, and the operator may also be in a good position to provide some emergency power for folks to charge their devices.

Then there's the comforting familiarity and ease-of-use of email. Hardly anyone alive today is unfamiliar with sending an email, and some of us can even remember at least one friend's email address. That lets most anyone send a "Hey, we're OK" message to someone outside the affected area, which can then be passed on as needed. Messages don't need to be limited in length — although attachments are not supported (hey, it's still a *radio* link) — so someone can send a few paragraphs of text if they need to.

Email

The PiGate has a simple but powerful email application built in. After connecting to the PiGate's WiFi hotspot, users log in to the email server, compose their emails and click Send. Just like anywhere else. The user interface was carefully designed to be smartphone- and touchscreen-friendly. It's a full-feature email application, including address books, folders and more, but with two exceptions: You can't add attachments, and the user can't delete anything.

Attachments can be simply too large for Winlink to efficiently handle, while it would be difficult to type in enough text to really faze the system. The

Figure 1: A PiGate in a typical enclosure. This particular case was 3D printed from a file downloadable on the PiGate website, leaving openings for all the important connections. Having a durable case helps when deploying a PiGate in a disaster area by protecting it while ensuring full functionality.

* c/o CQ magazine
Email: <N2IRZ@cq-amateur-radio.com>

delete function is removed to ensure there is a full record for the PiGate's operator of everything that was sent. So from the user's point of view, he/she is sending an email, plain and simple.

Sysop

From the System Operator's view, it's not much different. All of the emails are collected by the PiGate and sent into the Winlink network. If you have a packet radio connection to a local Winlink gateway (or if one can be temporarily set up for you), then a VHF radio would be used. If no packet connection is available (What? You haven't built a TARPN or AREDN network?), then you need to use a PACTOR modem and HF radio to connect directly into Winlink. Of course, anyone can use WINMOR and HF Packet to connect into Winlink, but you don't need a PiGate for that.

The Sysop's Winlink registration and email account is used to send every message. This means that the Sysop, as a licensed amateur radio operator, needs to advise the users of what's allowed on amateur radio, and what's not. In addition, any replies will all come to the Sysop's email account. This means if a reply is expected, the Sysop needs to make arrangements to get the reply into the right hands: A portable printer would be handy for this.

In the United States, only a licensed amateur radio operator may serve as the control operator for a PiGate. For VHF communications, you need a Technician class license or higher, while on HF you need at least a General class license. The control operator assumes all responsibility for its correct and legal use.

Hardware

If you are certain you will be using HF radio and a PACTOR modem, then all you need is a Raspberry Pi, but if there's ever a chance you'll be able to connect using packet, then you'll also want a TNC-Pi. The TNC-Pi is available for $40 as a kit from Coastal Chipworks <http://www.coastalchip.com/>, or you can get one fully assembled for a few dollars more. You'll need to make up or buy a few cables — from the modem (PACTOR or TNC-Pi) to the (HF or VHF) radio, and a USB-to-serial adapter to go from the Raspberry Pi to the PACTOR modem if you use one. Of course, you'll also have to deal with power and antennas, and it might be nice to put your PiGate into some kind of case to protect it.

Just like the TARPN node I wrote about in March, excluding radios, antennas and power, all this should be under $100. Indeed, if you have a TARPN node, the only thing you need to turn it into a PiGate is a new microSD card loaded with the Raspbian operating system and the PiGate software. For many, it would make sense to participate in a TARPN on a regular basis and, in a real emergency, take either a spare or an active node and repurpose it into a PiGate by swapping out the microSD card.

Figure 2: The PiGate's email server user interface. This image happens to show the administrator's view; a regular user would only be able to access the email application. The system operator can set a user ID and password for each user, as well as restrict Wi-Fi access with a password.

Software and Documentation

The PiGate software and documentation may be downloaded for free for at <www.pigate.net/downloads.html>. You can also download a file to have a case for the PiGate 3D printed if you like. If you search on Google you'll find quite a few ways to get something 3D printed locally, including some libraries and schools.

The PiGate documentation is very well-written, using plain language with enough detail for anyone to understand and follow. The setup and operation sections are the main focus, but the design goals and function description are useful for background and better understanding. The hardware and software details are clearly explained, and the procedure to "build" the PiGate is very easy to follow: Basically, after loading the Raspbian OS onto the Raspberry Pi, you download the PiGate software, copy it to the microSD card, and insert it into the Raspberry Pi.

Setup is a little more complicated, but not by much. There are several parameters that need to be set, and using a monitor, keyboard, and mouse will make this somewhat easier. Once configured, the PiGate runs "headless," meaning without a monitor or keyboard.

The first step is to log in as administrator and get to the PiGate management page. Only the administrator can access this page, using a password: Regular users can only access the email client. If you are not registered with Winlink as a user, you need to do that beforehand. You then set up your Winlink parameters (callsign & password), the PiGate clock, time zone and location, and add any local Winlink RMS stations. If you plan to use a PACTOR modem, you set a few communications parameters such as Baud rate, and that's about it for basic configuration.

Finally, there are several settings on the Main Menu page that need review. Most of these default to perfectly adequate settings, but if you wish, for example, to change the polling interval to the Winlink station from every 10 minutes to every 30 minutes because you have fewer users (such as overnight) you can do that here.

Some other items worth mentioning: You can configure an email footer, which is appended to every message sent. Something like "This message was sent using an emergency amateur radio link. Please do not reply to this message, thanks" might be handy, whether to promote amateur radio's role or to reduce the email clutter from replies you're not equipped to manage. I'm sure you can imagine other helpful things to put in here. Note that if your message is being delivered to an SMS (Short Message Service, a.k.a. text message) device, the footer is not sent to limit the size.

The documentation also includes sample forms for users to fill out and sign, to help make perfectly clear what limitations there are on message content. I'm not a lawyer, so I cannot say if a signed form can limit your liability to the FCC, but at least your users cannot say they did not know. There is also a handy section that describes the workflow for deploying your PiGate in a disaster area, covering the kinds of things you'll want to have and a step-by-step process to make everything operational.

Conclusion

Before I close, please understand that it's not possible to cover every small nuance of this process in detail. Even if you're not sure you want to try this, visit the PiGate web page and take a look around. There's even a video of the presentation Mark gave at the 2016 ARRL/TAPR Digital Communications Conference, which might sway your decision. If you already have the hardware, it's not even a big stretch to make up an SD card.

For some, the Winlink registration might be a small roadblock, but it is free (donations gladly accepted) so money isn't an issue. The Winlink global email network is one project from ARSFi, the Amateur Radio Safety Foundation <https://www.arsfi.org/>. Indeed, they have a deal with Amazon <https://smile.amazon.com> to get a small portion of what you spend as a donation: Simply pick ARSFI as your charity. It's the same Amazon products, prices, account, and everything.

If you built a TARPN node, you'll notice you paid an extra $2 for the I2C support to be pre-loaded to the TNC-PI. Converting to a PiGate doesn't remove any of that, so no harm.

If you heeded my advice in March to make your plans for Dayton, please stop by the CQ booth and say hello, or perhaps something else? Good or bad, I really do love hearing from you.

– Until then, 73 de N2IRZ.

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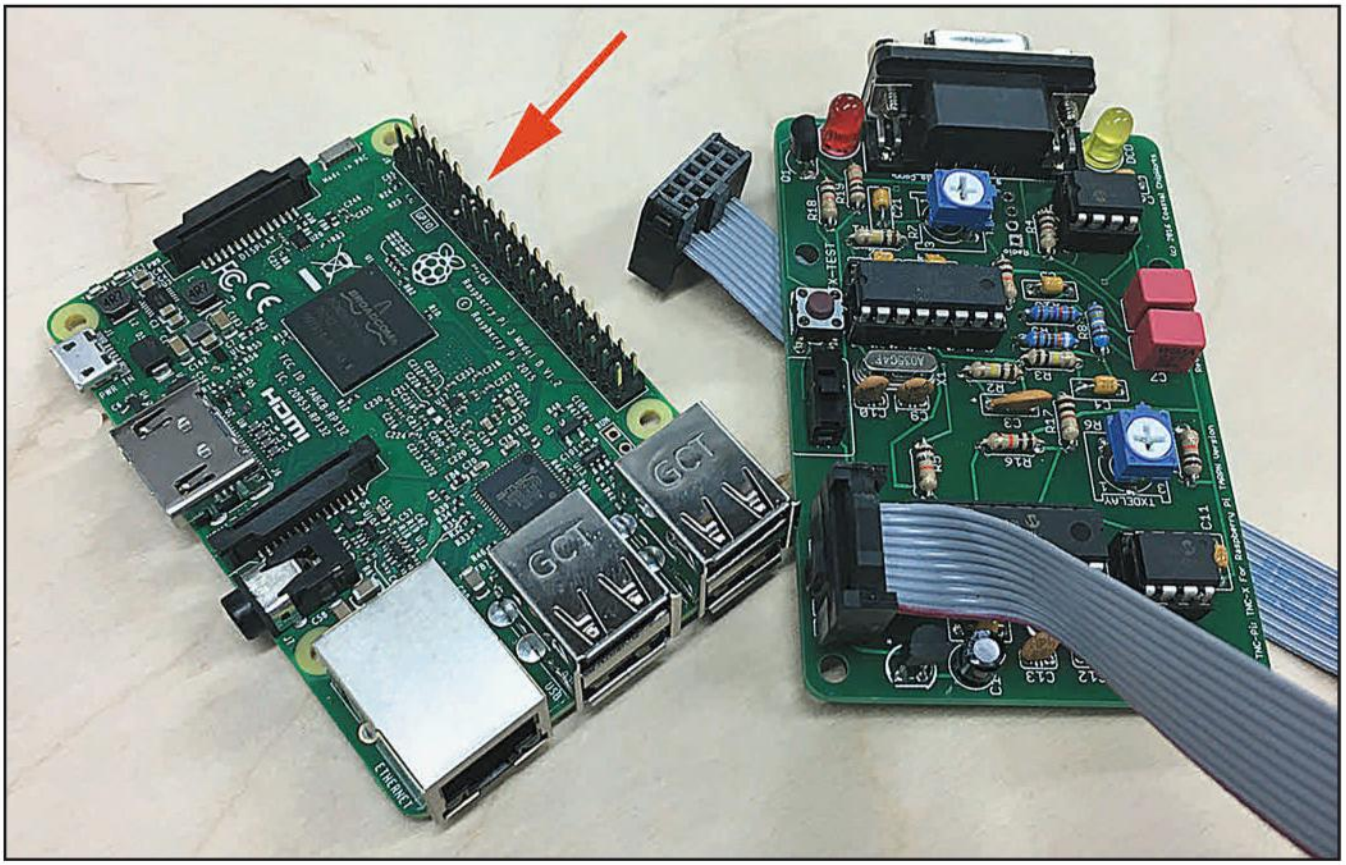

Figure 3: A Raspberry Pi mini-computer and a TNC-Pi, same as we saw in the March 2017 column on building a TARPN. In this image, the TNC-Pi is connected to the Raspberry Pi using a ribbon cable — note the cut pins (arrow) to accommodate the connector on the Raspberry Pi. One can also plug the TNC-Pi directly onto the header, but you have to insulate the TNC-Pi from the USB connector metal coverings to prevent a short circuit. A few slices of electrical tape will do nicely.